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∴ The total for these is $9000\times10\times10=$ 900000.

Ten, *eleven*, ..., *nineteen*—20 syllables—of the first and second orders, are each pronounced once in every hundred.

∴ The total for these is $20\times10000=$ 200000.

The same, of the fourth and fifth orders, are each pronounced 1000 times in every hundred thousand.

∴ The total for these is $10\times20\times10000=$ 200000.

Twenty, *thirty*, ..., *ninety*—17 syllables—of the second order, are each pronounced 10 times in every hundred.

∴ The total for these is $10\times17\times10000=$ 1700000.

The same, of the fifth order, are each pronounced 10000 times in every hundred thousand.

∴ The total for these is $10\times17\times10000=$ 1700000.

One hundred, *two hundred*, ..., *nine hundred*—28 syllables—of the third order, are each pronounced 100 times in every thousand.

∴ The total for these is $28\times100\times1000=$ 2800000.

The same, for the sixth order, are each pronounced 100000 times.

∴ The total for these is $28\times100000=$ 2800000.

Thousand is pronounced 999000 times.

∴ The total for this word is 1998000.

The number of syllables in *one million* is 3.

The grand total is 13198003.

∴ 13198003 seconds=152 days, 18 hours, 6 minutes, 43 seconds, the time required.

[Chas. C. Crose, New Windsor, Maryland, sent in a solution of problem 49. The solution is by Algebra and is very good, but as the space in the MONTHLY is very limited even for unsolved problems, we reluctantly omit his solution. The published solution of problem 49 is not valuable because of its brevity, but because each step is the statement of a very elementary mathematical proposition, and hence can be comprehended by any one who has mastered these simple propositions. It is no discredit to a solution to be long if at the same time it is clear in its statements. EDITOR.]

ALGEBRA.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

54. Proposed by Professor E. W. MORRELL, Department of Mathematics, Montpelier Seminary, Montpelier, Vermont.

Transform $x^4+y^4+z^4-2y^2z^2-2z^2x^2-2x^2y^2$ into a product.

I. Solution by ROBERT E. MORITZ, B. Sc., Professor of Mathematics in Hastings College, Hastings, Nebraska; and EDGAR KESNER, Boulder, Colorado.

Adding and subtracting $4y^2z^2$, we have

$$(x^4+y^4+z^4-2y^2z^2-2x^2z^2+2y^2z^2)-4y^2z^2,=(x^2-y^2-z^2)^2-(2yz)^2.$$

$$\begin{aligned}(x^2-y^2-z^2)^2-(2yz)^2&=(x^2-y^2-z^2-2yz)(x^2-y^2-z^2+2yz)\\&=[x^2-(y+z)^2][x^2-(y-z)^2]\\&=(x-y-z)(x+y+z)(x-y+z)(x+y-z),\\ \text{or }&-(y+z-x)(x+y+z)(x-y+z)(x+y-z).\end{aligned}$$

Similarly solved by *O. W. ANTHONY*, *J. SCHEFFER*, *C. D. SCHMITT*, *H. C. WILKES*, *B. F. YANNEY*, and *G. B. M. ZERR*.

II. Solution by A. P. READ, A. M., Clarence, Missouri.

By the method of the last solution, we get

$$[x^2-(y+z)^2][x^2-(y-z)^2]=(x-y-z)(x+y+z)(x-y+z)(x+y-z).$$

In a similar way by adding and subtracting first $4x^2z^2$ and then $4x^2y^2$, we obtain $(y-x-z)(y+x+z)(y-x+z)(y+x-z)$,

and $(z-x-y)(z+x+y)(z-x+y)(z+x-y)$.

Also solved in this way by *M. A. GRUBER*.

III. Solution by ALFRED HUME, C. E., D. Sc., Professor of Mathematics, University of Mississippi, University, Lafayette County, Mississippi.

$x^4+y^4+z^4-2y^2z^2-2z^2x^2-2x^2y^2$ may be expressed as the determinant

$$\begin{vmatrix}0&1&1&1\\1&0&z^2&y^2\\1&z^2&0&x^2\\1&y^2&x^2&0\end{vmatrix}$$

which, as in Burnside and Panton's *Theory of Equations*, second edition, page 253, or, as in Weld's *Theory of Determinants*, pages 41 and 42, may be resolved into the factors

$$-(x+y+z)(y+z-x)(z+x-y)(x+y-z).$$

55. Proposed by MARCUS BAKER, M. A., U. S. Geological Survey, Washington, D. C.

Two right triangles ABC and ABD are so placed as to have one side $x(=AB)$ in common. From P the intersection of their hypotenuses is drawn c perpendicular to x. Knowing the hypotenuses $a=39$ feet and $b=25$ feet, and the perpendicular $c=12\frac{6}{7}$ feet, find x. Note this theorem

$$\frac{1}{m}+\frac{1}{n}+\frac{1}{c}\text{ or }\frac{1}{\sqrt{a^2+x^2}}+\frac{1}{\sqrt{b^2-x^2}}=\frac{1}{c},$$

where m and n are the altitudes of the two triangles, respectively. Also find locus of P. Discuss the case when the triangles are general (not right angled).